PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61B 5/00, G08B 25/00 — A1

(11) International Publication Number: WO 99/04685

(43) International Publication Date: 4 February 1999 (04.02.99)

(21) International Application Number: PCT/FI98/00603

(22) International Filing Date: 22 July 1998 (22.07.98)

(30) Priority Data:

973128	25 July 1997 (25.07.97)	FI
973386	19 August 1997 (19.08.97)	FI

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

With international search report.

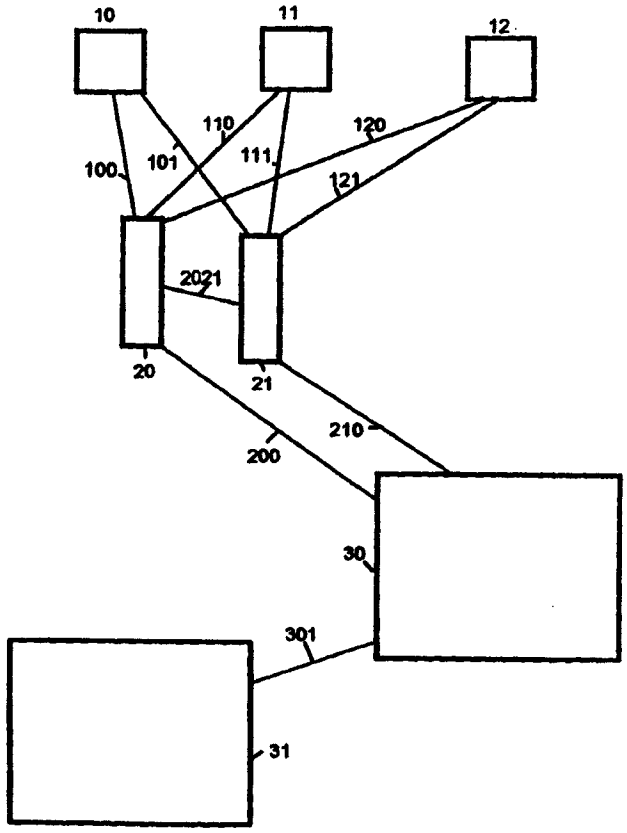
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(71)(72) **Applicant and Inventor:** VÄÄNÄNEN, Mikko [FI/GB]; 692 King's College, Cambridge BB2 1ST (GB).

(54) **Title:** A PERSONAL HEALTH STATUS ALARM METHOD

(57) **Abstract**

The invention relates to an automatic personal alarm method. The invention characteristically comprises at least one mobile station (20, 21, 22, 23, 24), at least one health status measuring means (10, 11, 12, 13), at least one emergency alarm centre (30) and communications connections (100, 101, 102, 103, 104, 110, 111, 120, 121), via which the mobile stations (20, 21, 22, 23, 24) and the health status measuring means (10, 11, 12, 13) are arranged to communicate with each other, and/or communications connections (2021), via which mobile stations are arranged to communicate health status information to each other, and communications connections (200, 201, 202, 203, 204), via which the mobile stations (20, 21, 22, 23, 24) and the emergency alarm centres (30) are arranged to communicate with each other. The health status measuring means measure physiological indicators, such as heart rate, EKG or dehydration, of the user, and upon an abrupt or dangerous change in the health status of the user sends an emergency signal to a mobile station (20, 21, 22, 23, 24). The mobile station (20, 21, 22, 23, 24) then further transmits the emergency signal to a relevant emergency alarm centre (30).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

A personal health status alarm method

The invention relates to an automatic personal health status alarm method . The invention further relates to a health status alarm method, which is characterised by a mobile station, a health status measuring means, and a communications connection between the health status measuring means and the mobile station.
The invention also relates to a health status alarm method, which is characterised by at least one mobile station, at least one health status measuring means, and a communications connection between all or some of the health status measuring means and all or some of the mobile stations.

Prior Art

The current procedure in case of an accident or sudden illness, for instance a heart attack, has so far relied on other people observing the outbreak of illness or accident and calling for assistance. Every country has an emergency phone line , for example 112 in Finland and 911 in the US, where people may report emergencies to the local emergency alarm centre, and the requests are answered by dispatching suitable help, such as police, ambulance or the fire brigade. However, in cases of very special health hazards, such as excess radioactive dose, the local emergency alarm centre can only rarely help and, thus it is many times better to contact the special centre or station responsible of providing help in these rarer cases with an suitable emergency request.

There are serious disadvantages relating to the prior art. Many times the help is too late because there are no other people to observe the outbreak of illness or accident. Also, sometimes when people observe the incident, they do not know what to do, or do not want to call for assistance. Even if the observers do call, they are many times hysterical, and their description of the emergency is thus presented in an unclear way to the emergency alarm centre. Many times people also simply forget to mention some relevant things relating to the emergency concerned. A serious disaster may occur if an ambulance arrives at an emergency scene being prepared to treat fainting by dehydration, when in fact people are suffering from an heart attack.

Due to the aforementioned disadvantages many lives are lost unnecessarily everyday. For example in the case of a heart attack the survival probability of the patient decreases significantly with every extra minute that it takes for the first aid or the ambulance to arrive. The first aid treatment of a severe heart attack might also require some special instruments, and in this case it is a significant help that the emergency alarm centre can be sure that the diagnosis of the outbreak of illness is correct.

The objective of this invention is to remove some of these disadvantages. The method in accordance with the invention will reduce the time it takes for the emergency signal to arrive at the emergency alarm centre. The emergency signal is sent automatically and immediately, thus shortening the delay times due to human factors. The method in accordance with the invention has the capability to give accurate descriptions of the emergency, such as the cause, location etc., which might be presented unclearly by a person in panic. Even more importantly, the system will also work in cases where no people observe the incident.

A further additional advantage is that the invention has many embodiments, out of which some have even alternative uses, for example in competitive sport.

In this application it is assumed that a mobile station can be a wireless phone as well.

The aforementioned advantages are achieved with a personal health status alarm method which characteristically comprises a mobile station , a health status measuring means , an emergency alarm centre and a communications connection, via which the mobile station and the health status measuring means are arranged to communicate with each other, and a communications connection, via which the mobile station and the emergency alarm centre are arranged to communicate with each other.

The aforementioned advantages are also achieved with a personal health status alarm method which characteristically comprises at least one mobile station, at least one health status measuring means, at least one emergency alarm centre and communications connections, via which the mobile stations and the health status measuring means are arranged to communicate with

each other, and/or communications connections, via which mobile stations are arranged to communicate health status information to each other, and communications connections, via which the mobile stations and the emergency alarm centres are arranged to communicate with each other.

The personal health status measuring means is also characteristically arranged to measure physiological parameters from the user,
the personal health status measuring means is arranged to compare the measured values of physiological parameters to previous values and/or to threshold values of the physiological parameters and/or to some relevant mathematical relation or function, and
On the basis of this comparison the personal health status measuring means is arranged to send an emergency signal via a communications connection to a mobile station.

The some of the aforementioned advantages are also achived with an personal health status measuring means , which characteristically is arranged to measure physiological parameters or signals of the user, and
- the personal health status measuring means is arranged to transmit the physiological parameters or signals as analog or digital signals to the mobile station continuously or at certain intervals according to the preference, or the type of signal processing ability of the mobile station.

Embodiments

Some advantageous embodiments of the invention are described in the following with reference to the attached drawings.

Fig 1. presents a certain implementation of the personal health status alarm method, comprising only one health status measuring means, one mobile station and one emergency alarm centre.

Fig 1B. presents a certain embodiment of the interactions of a mobile station and a health status measuring means in closer detail.

Fig 2. presents a certain advantageous embodiment of the personal health status alarm method, comprising several health status measuring means, one mobile station and one emergency alarm centre.

Fig 3. presents a certain advantageous embodiment of the personal health status alarm method, comprising one health status measuring means, several mobile stations and one emergency alarm centre.

Fig 4. presents a certain network oriented implementation of the personal health status alarm method, comprising several health status measuring means, several mobile stations and one emergency alarm centre.

In figure 1. the health status measuring means 10 features a capability to observe physiological variables, and compare the values of the measurements preferably to certain threshold values. The health status measuring means may comprise several different communications means. These may include different data and/or speech mobile communications systems, such as NMT or GSM or CDMA or other, facsimile, electronic mail, SMS messages, telemetric connections, or any other form of mobile communication. The mobile station 20 may also comprise several different communications means. These communications means may as well include different data and/or speech mobile communications systems, such as NMT or GSM or CDMA or other, facsimile, electronic mail, SMS messages, telemetric connections, or any other form of mobile communication. The emergency alarm centre 30 advantageously comprises a communications terminal, which supports different data and/or speech communications systems. The emergency alarm centre 30 may be located anywhere, and it may feature especially any mobile communications systems. The preferable uses for the emergency alarm centre 30 would be, for example, at the alarm centres of hospitals, fire brigades, police stations, mobile communications base stations, or with the person's personal doctor.

The communications connections 100 and 200 are realised advantageously using mobile electromagnetic communication, but the connection 100 may be realised in some embodiments with a wire connection. The connection 100 is preferably a radio, a telemetric or an infra-red connection, and the connection 200 is preferably a radio connection.

The health status measuring means 10 is in connection with the mobile station 20 through the communications connection 100. The mobile station 20 is further connected to the emergency alarm centre 30 through the communications connection 200. When the health status measuring means 10 observes an abrupt change in the health status of the human or animal wearing it, it transmits an emergency signal to the mobile station 20. After receiving this emergency signal the mobile station 20 contacts the emergency alarm centre 30 with a signal containing instructions on the help needed by the human or animal wearing the health status measuring means 10, and possibly some information concerning the health status of the human or animal in question.

The abruptness of the change in the health status of the user of the health status measuring means 10 is judged by comparing the measured physiological parameters to some threshold values. The threshold values can be composed of previous measurements of the physiological parameters in question using statistical analysis, or they can be simply set by a doctor or a physician. In addition to specific threshold values, some mathematical relations or functions may be used instead of the threshold values to provide a reference point for the measurements of the health status measuring means 10.

The analysis of the abruptness of the change in the health status may be implemented in many ways in accordance with the invention. The health status measuring means 10 may, for example, continuously transmit measurements to the mobile station 20 via connection 100, in which case the aforementioned analysis of the health status is carried out in the mobile station. The other alternative is that the whole aforementioned health status analysis is carried out in the health status measuring means 10 and the mobile station 20 only receives and transmits the emergency signal further to the emergency alarm centre 30. Alternatively, different parts of the aforementioned analysis can preferably be divided among the mobile station 20, health status measuring means 10, and in some cases even among the emergency alarm centre 30. Especially the signal processing parts of a preferably digital mobile station could be advantageously utilised in recognizing changes in health status, provided the health status measuring means 10 is capable of transmitting a signal.

One preferable embodiment of the invention is a system, where the health status measuring means 10 is effectively a heart rate monitor or a EKG (Elektrokardiogram) -meter and the mobile station 20 is preferably a mobile phone with data compatibility, for example a GSM (Global System for Mobile communications) -phone. In this embodiment, if the heart rate behaves abnormally or the EKG values are significantly out of the ordinary, the heart rate- and/or EKG monitor 10 contacts the mobile phone 20 automatically via connection 100, and the mobile station 20 further calls to the emergency alarm centre 30 automatically, which may in this case be located, for example, in a local hospital, ambulance, or a doctor's office. In this case the connection 200 may preferably be an ordinary telecommunications connection.

The mobile station 20 may just establish the contact to the emergency alarm centre 30, in which case the people or the person at the emergency alarm centre 30 only knows that this specific person wearing the heart rate- or EKG monitor has problems with heart function. However, it is also possible to give the accurate location of the mobile phone 20 with the emergency signal, and information concerning the health status of the person or animal may be transmitted with the emergency signal as well. It is already known how base stations can locate mobile stations (see reference document EP 0320913). With the information contained in the emergency signal the people at the emergency alarm centre 30 may deduce what help is needed and where. Alternatively, a computer program may also deduce the nature of help needed at the specified location and transmit this information further to people in control of the help facilities. To summarize this in more practical terms, the aforementioned embodiment in accordance with the invention will automatically and immediately direct ambulances and police cars etc. to destinations where their assistance is needed.

The health status measuring means 10 in Figure 1. may also comprise means for detecting physiological variables other than EKG or heart rate. The health status measuring means 10 may be arranged to measure the extent of radioactive radiation dose, UV radiation, dehydration, body temperature, synaptic nerve activity, blood pressure, brain activity, electrostatic potential of the skin, mechanical shock or pressure imposed on the body or any other physiological indicator, in which an abrupt change might cause a health risk, illness or death.

Especially an embodiment featuring radioactive radiation measuring means as the health status measuring means 10 might improve safety at work on nuclear power stations etc.. In this preferable embodiment, the nuclear power plant could have its own emergency alarm centre 30, which could keep track of the health of all people being exposed to radioactive radiation at work.

Especially an embodiment featuring a sensor for mechanical shock or pressure as the health status measuring means 10 might improve, for example, safety in traffic for many cyclists.

The mobile station 20 may comprise several different communications means. These may include different data and/or speech mobile communications systems, such as NMT or GSM or CDMA or other, facsimile, electronic mail, SMS messages or any other form of mobile communication. In the case of alarm the mobile station 20 can transmit an emergency signal in data form or a previously recorded voice mail, but in addition, the connection 100 may be left open so the emergency alarm centre 30 can listen or follow by other means in real time the development of the situation in the surroundings of mobile station 20 after the alarm. The emergency alarm centre 30 can also follow the measurements of the health status measuring means 10 in real time if both the communications connections 100, 200 are left accessible. The mobile station 20 may also be designed and constructed to the same compartment as the health status measuring means 10.

In another preferable embodiment of the invention the connection 100 is held continuously open, and the mobile station 20 may continuously follow the measurements of the health status measuring means 10. In another further preferable embodiment of the invention the communications connection 200 is held continuously open as well, in which case the emergency alarm centre 30 can continuously follow the measurements of the health status measuring means 10. It is also possible to arrange the connections 100, 200 to be open at certain known intervals for the transfer of health status information. The establishment of any communications connection 100, 200 may be initiated from any device 10, 20, 30 in the system. The aforementioned embodiment is especially advantageous in medical surveillance of people with heart disorders.

The figure 1B. describes an advantageous embodiment of the technical implementation of the case where the connection 200 is held continuosly open. Many relevant physiological indicators such as EKG, heart rate, brain activity, electrostatic potential of skin, and others can be presented as analog signals. However, speech is also an analog signal, but in a digital cellular mobile station, such as a GSM mobile phone, the analog speech signal is adapted to a digital signal, which is further processed in the DSP (Digital Signal Processor) of the mobile station. The DSP's of modern digital cellular mobile phones comprise many ways of analysing the coded speech signal, such as calculating autocorrelation coefficients, reflection coefficients, logarithmic area ratios and other parameters, which may be used in analysing the signal and replacing disturbances and noise from the signal. Noise and impulses from the signal may be recognized by using many modifications of the LPC (Linear Predictive Coding)-method, linear interpolation, polynomic interpolation etc.

In this embodiment the health status measuring means 10 constantly transmits an analog signal to the mobile station 20, which uses its signal processing means to recognize possible alarming changes in the health status signal. In case the health status measuring means 10 measures EKG, for example, can the waveform of an EKG-signal already be inserted in the digital cellular phone, and waveform of the received health status signal is compared to the reference EKG-signal, and huge deviations from the reference-signal are detected. It is also possible to detect abnormal EKG-pulses by similar methods with which abnormal noise and impulses are detected from a speech signal, ie. by detecting unreasonable amplitudes and timings by the aforementioned mathematical methods. In this embodiment, the A/D-adapter 5 may lie anywhere between the DSP 7 of the mobile station 20 and the health status measuring means 10.

Figure 2. features many health status measuring means 10, 11, 12, 13 in connection with one mobile station 20, which provides the only communications access to the emergency alarm centre 30. This embodiment is practical and economical in cases where the people wearing the health status measuring means 10 live or work together. If the range of the connections 100, 101, 102 and 103 is adequate, for instance a retired couple might benefit from getting only one mobile station, provided they spend most of their time near enough each other for the connection 100, 101, 102, or 103

to function. In this embodiment, the mobile station 20 recognizes which health status measuring means 10, 11, 12, 13 sent the emergency signal, if it is not already contained in the signal, and transmits the information location, health status, type of help needed to the emergency alarm centre 30 as outlined in the explanation of figure 1.

Figure 3. features one health status measuring means 10 in connection with several mobile stations 20, 21, 22, 23, 24. This embodiment is essential when establishing connection from the mobile station 20, 21, 22, 23, 24 to the emergency alarm centre 30 may be difficult. This kind of situation is likely to arise if there are many cellular networks available and their radio coverage differs. If one mobile station 20 is subscribed to only one cellular network, there might be areas where this particular mobile station 20 fails to form a connection because of poor radio coverage, even though some other cellular network might have adequate radio coverage on the area in question. However, if there are several mobile stations 20, 21, 22, 23, 24 subscribed to different cellular networks and the health status measuring means 10 can establish connection 100 to all or some of them, it is likely that even though some mobile station, say 22, 24, might fail in establishing connection to the emergency alarm centre 30, other mobile stations, say 20,21,23, may indeed succeed. One preferable but optional feature of this embodiment is that if there are more than one successful mobile stations 20, 21, 22, 23, 24, only one of these will transmit the emergency signal to the emergency alarm centre 30, and other mobile stations will abort their messages in order to avoid congestion, confusion and false alarms. It is also possible that the different mobile stations 20, 21, 22, 23, 24 are carried by different people or lie in different locations. In some buildings there are rooms which have poor radio coverage, while other rooms do not. In this kind of situation, one of the mobile stations 20, 21, 22, 23, 24 can be situated in a room with guaranteed radio coverage, just to make sure that at least one radio connection to the emergency alarm centre can be established.

The embodiment in question is also useful in situations where other disturbances are likely to cause uncontinuous operation time for a single mobile station 20, such as disturbances caused by recharging the battery etc.. Thus, the aforementioned embodiment allows mobile stations 20, 21, 22, 23, 24 to work shiftwise.

Figure 4. features several health status measuring means 10, 11, 12, several mobile stations 20, 21, and an emergency alarm centre 30. All or some of the health status measuring means 10, 11, 12 are connected to mobile stations 20, 21 via communications connections 100, 101, 110, 111, 120, 121. The mobile stations are further connected to each other with connection 2021 and to the emergency alarm centre 30 with the connections 200, 210. The emergency alarm centre 30 may also exchange information with the other emergency alarm centre 31 through connection 301.

A preferable embodiment of the invention can be effectively utilised in team operations which may impose health hazards to the team members. Such operations may include police operations, life saving operations, diving operations, operations of the fire brigade, some military operations, to name just a few. In this embodiment of the invention if any of the health status measuring means 10, 11, 12 executes an alarm, the alarm can be routed via many alternative ways to the emergency alarm centre 30. For example, in a fire saving operation a fireman carrying the health status measuring means 10 and mobile station 20 might get into an accident and break his mobile station 20, thus abolishing the connection 100. In this case, the embodiment in question still allows the health status of the user of health status measuring means 10 to be monitored, and the emergency signals and the monitoring are carried out via the connections 101 and 210.

From the above explanation it is obvious that the emergency alarm centres 30 , 31 can have communications connections to other emergency alarm centres and exchange information via these connections.

Another further advantageous embodiment of the invention can be utilised in athletic training. In this embodiment the health status measuring means 10, 11, 12 measures some relevant physiological indicator related with the extent of physical exercise, such as heart rate or calory consumption. The mobile stations 20, 21 receive exercise status information from all health status measuring means 10, 11, 12 via connections 100, 101, 110, 111, 120, 121 and/or from other mobile stations via connection 2021. With this system a particular athelete carrying, say health status measuring means 10 and mobile station 20 can receive the exercise status information of another athelete carrying, say health status measuring means 11 and mobile station 21, and compare this exercise information to his own exercise information. The

exercise information may be displayed by either the health status measuring means 10, 11, 12, or the mobile station 20, 21. In this embodiment of the invention the mobile station 20, 21 and the health status measuring means 10, 11, 12 are preferably incorporated to the same unit to increase the convenience in use during active training.

The exercise information of both atheletes can also be read from the emergency alarm centre 30, which in this case is preferably a communications terminal located with the coach of the two atheletes. This embodiment of the invention is especially valuable in very technical competitive sports, such as rowing, cycling, swimming etc., where the objective is to move fast with using minimum power and optimum technique.

All of the aforementioned embodiments may be realised with different kinds of health status measuring means 10, 11, 12, 13. The health status measuring means 10, 11, 12, 13 may measure all or some of the following physiological parameters: radioactive radiation dose, UV radiation, dehydration, heart rate, EKG, body temperature, blood pressure, synaptic nerve activity, brain activity, electrostatic potential of the skin, mechanical shock or pressure imposed on the body, or any other relevant physiological parameter. Especially combining the measurement of some related and relevant physiological parameters can be an advantageous embodiment to some users. For example, for people suffering from excess exposure to the sun a health status measuring means 10, 11, 12, 13 measuring dehydration, UV dose and body temperature may detect the relevant health hazards with high accuracy.

In all of the described embodiments, it is always possible for the user of the health status measuring means to cancel an false emergency signal by performing some simple operation on either the health status measuring means (10, 11, 12, 13) or on the mobile station (20, 21, 22, 23, 24) or on to both. The operation in question could be eg. pushing a cancel button.

The invention has been explained with reference to the aforementioned embodiments. However, it is clear that the invention is not only limited to these embodiments, but covers all embodiments within the spirit and scope of the invention and in the framework of the following claims.

A method for mobile analysis and communication of health status information

This application requests priority from the Finnish patent application number: 973128, titled "a personal health status alarm method". The following explanation relates to the overall system presented in the priority application. The explanation relating to the invention of this application is at the end of the text. The claims concern only the invention presented in this application.

A personal health status alarm method

The invention relates to an automatic personal health status alarm method . The invention further relates to a health status alarm method, which is characterised by a mobile station, a health status measuring means, and a communications connection between the health status measuring means and the mobile station.
The invention also relates to a health status alarm method, which is characterised by at least one mobile station, at least one health status measuring means, and a communications connection between all or some of the health status measuring means and all or some of the mobile stations.

Prior Art

The current procedure in case of an accident or sudden illness, for instance a heart attack, has so far relied on other people observing the outbreak of illness or accident and calling for assistance. Every country has an emergency phone line , for example 112 in Finland and 911 in the US, where people may report emergencies to the local emergency alarm centre, and the requests are answered by dispatching suitable help, such as police, ambulance or the fire brigade. However, in cases of very special health hazards, such as excess radioactive dose, the local emergency alarm centre can only rarely help and, thus it is many times better to contact the special centre or station responsible of providing help in these rarer cases with an suitable emergency request.

There are serious disadvantages relating to the prior art. Many times the help is too late because there are no other people to observe the outbreak of illness or accident. Also, sometimes when people observe the incident, they do not know what to do, or do not want to call for assistance. Even if the observers do call, they are many times hysterical, and their description of the emergency is thus presented in an unclear way to the emergency alarm centre. Many times people also simply forget to mention some relevant things relating to the emergency concerned. A serious disaster may occur if an ambulance arrives at an emergency scene being prepared to treat fainting by dehydration, when in fact people are suffering from an heart attack.

Due to the aforementioned disadvantages many lives are lost unnecessarily everyday. For example in the case of a heart attack the survival probability of the patient decreases significantly with every extra minute that it takes for the first aid or the ambulance to arrive. The first aid treatment of a severe heart attack might also require some special instruments, and in this case it is a significant help that the emergency alarm centre can be sure that the diagnosis of the outbreak of illness is correct.

The objective of this invention is to remove some of these disadvantages. The method in accordance with the invention will reduce the time it takes for the emergency signal to arrive at the emergency alarm centre. The emergency signal is sent automatically and immediately, thus shortening the delay times due to human factors. The method in accordance with the invention has the capability to give accurate descriptions of the emergency, such as the cause, location etc., which might be presented unclearly by a person in panic. Even more importantly, the system will also work in cases where no people observe the incident.

A further additional advantage is that the invention has many embodiments, out of which some have even alternative uses, for example in competitive sport.

In this application it is assumed that a mobile station can be a wireless phone as well.

The aforementioned advantages are achieved with a personal health status alarm method which characteristically comprises a mobile station , a health

status measuring means , an emergency alarm centre and a communications connection, via which the mobile station and the health status measuring means are arranged to communicate with each other, and a communications connection, via which the mobile station and the emergency alarm centre are arranged to communicate with each other.

The aforementioned advantages are also achieved with a personal health status alarm method which characteristically comprises at least one mobile station, at least one health status measuring means, at least one emergency alarm centre and communications connections, via which the mobile stations and the health status measuring means are arranged to communicate with each other, and/or communications connections, via which mobile stations are arranged to communicate health status information to each other, and communications connections, via which the mobile stations and the emergency alarm centres are arranged to communicate with each other.

The personal health status measuring means is also characteristically arranged to measure physiological parameters from the user,
the personal health status measuring means is arranged to compare the measured values of physiological parameters to previous values and/or to threshold values of the physiological parameters and/or to some relevant mathematical relation or function, and
On the basis of this comparison the personal health status measuring means is arranged to send an emergency signal via a communications connection to a mobile station.

The some of the aforementioned advantages are also achived with an personal health status measuring means , which characteristically is arranged to measure physiological parameters or signals of the user, and
- the personal health status measuring means is arranged to transmit the physiological parameters or signals as analog or digital signals to the mobile station continuously or at certain intervals according to the preference, or the type of signal processing ability of the mobile station.

Embodiments

Some advantageous embodiments of the invention are described in the following with reference to the attached drawings.

Fig 1. presents a certain implementation of the personal health status alarm method, comprising only one health status measuring means, one mobile station and one emergency alarm centre.

Fig 1B. presents a certain embodiment of the interactions of a mobile station and a health status measuring means in closer detail.

Fig 2. presents a certain advantageous embodiment of the personal health status alarm method, comprising several health status measuring means, one mobile station and one emergency alarm centre.

Fig 3. presents a certain advantageous embodiment of the personal health status alarm method, comprising one health status measuring means, several mobile stations and one emergency alarm centre.

Fig 4. presents a certain network oriented implementation of the personal health status alarm method, comprising several health status measuring means, several mobile stations and one emergency alarm centre.

In figure 1. the health status measuring means 10 features a capability to observe physiological variables, and compare the values of the measurements preferably to certain threshold values. The health status measuring means may comprise several different communications means. These may include different data and/or speech mobile communications systems, such as NMT or GSM or CDMA or other, facsimile, electronic mail, SMS messages, telemetric connections, or any other form of mobile communication. The mobile station 20 may also comprise several different communications means. These communications means may as well include different data and/or speech mobile communications systems, such as NMT or GSM or CDMA or other, facsimile, electronic mail, SMS messages, telemetric connections, or any other form of mobile communication. The emergency alarm centre 30 advantageously comprises a communications terminal, which supports different data and/or speech communications systems. The emergency alarm centre 30 may be located anywhere, and it may feature especially any mobile communications systems. The preferable uses for the

emergency alarm centre 30 would be, for example, at the alarm centres of hospitals, fire brigades, police stations, mobile communications base stations, or with the person's personal doctor.

The communications connections 100 and 200 are realised advantageously using mobile electromagnetic communication, but the connection 100 may be realised in some embodiments with a wire connection. The connection 100 is preferably a radio, a telemetric or an infra-red connection, and the connection 200 is preferably a radio connection.

The health status measuring means 10 is in connection with the mobile station 20 through the communications connection 100. The mobile station 20 is further connected to the emergency alarm centre 30 through the communications connection 200. When the health status measuring means 10 observes an abrupt change in the health status of the human or animal wearing it, it transmits an emergency signal to the mobile station 20. After receiving this emergency signal the mobile station 20 contacts the emergency alarm centre 30 with a signal containing instructions on the help needed by the human or animal wearing the health status measuring means 10, and possibly some information concerning the health status of the human or animal in question.

The abruptness of the change in the health status of the user of the health status measuring means 10 is judged by comparing the measured physiological parameters to some threshold values. The threshold values can be composed of previous measurements of the physiological parameters in question using statistical analysis, or they can be simply set by a doctor or a physician. In addition to specific threshold values, some mathematical relations or functions may be used instead of the threshold values to provide a reference point for the measurements of the health status measuring means 10.

The analysis of the abruptness of the change in the health status may be implemented in many ways in accordance with the invention. The health status measuring means 10 may, for example, continuously transmit measurements to the mobile station 20 via connection 100, in which case the aforementioned analysis of the health status is carried out in the mobile station. The other alternative is that the whole aforementioned health status

analysis is carried out in the health status measuring means 10 and the mobile station 20 only receives and transmits the emergency signal further to the emergency alarm centre 30. Alternatively, different parts of the aforementioned analysis can preferably be divided among the mobile station 20, health status measuring means 10, and in some cases even among the emergency alarm centre 30. Especially the signal processing parts of a preferably digital mobile station could be advantageously utilised in recognizing changes in health status, provided the health status measuring means 10 is capable of transmitting a signal.

One preferable embodiment of the invention is a system, where the health status measuring means 10 is effectively a heart rate monitor or a EKG (Elektrokardiogram) -meter and the mobile station 20 is preferably a mobile phone with data compatibility, for example a GSM (Global System for Mobile communications) -phone. In this embodiment, if the heart rate behaves abnormally or the EKG values are significantly out of the ordinary, the heart rate- and/or EKG monitor 10 contacts the mobile phone 20 automatically via connection 100, and the mobile station 20 further calls to the emergency alarm centre 30 automatically, which may in this case be located, for example, in a local hospital, ambulance, or a doctor's office. In this case the connection 200 may preferably be an ordinary telecommunications connection.

The mobile station 20 may just establish the contact to the emergency alarm centre 30, in which case the people or the person at the emergency alarm centre 30 only knows that this specific person wearing the heart rate- or EKG monitor has problems with heart function. However, it is also possible to give the accurate location of the mobile phone 20 with the emergency signal, and information concerning the health status of the person or animal may be transmitted with the emergency signal as well. It is already known how base stations can locate mobile stations (see reference document EP 0320913). With the information contained in the emergency signal the people at the emergency alarm centre 30 may deduce what help is needed and where. Alternatively, a computer program may also deduce the nature of help needed at the specified location and transmit this information further to people in control of the help facilities. To summarize this in more practical terms, the aforementioned embodiment in accordance with the invention will

automatically and immediately direct ambulances and police cars etc. to destinations where their assistance is needed.

The health status measuring means 10 in Figure 1. may also comprise means for detecting physiological variables other than EKG or heart rate. The health status measuring means 10 may be arranged to measure the extent of radioactive radiation dose, UV radiation, dehydration, body temperature, synaptic nerve activity, blood pressure, brain activity, electrostatic potential of the skin, mechanical shock or pressure imposed on the body or any other physiological indicator, in which an abrupt change might cause a health risk, illness or death.

Especially an embodiment featuring radioactive radiation measuring means as the health status measuring means 10 might improve safety at work on nuclear power stations etc.. In this preferable embodiment, the nuclear power plant could have its own emergency alarm centre 30, which could keep track of the health of all people being exposed to radioactive radiation at work.

Especially an embodiment featuring a sensor for mechanical shock or pressure as the health status measuring means 10 might improve, for example, safety in traffic for many cyclists.

The mobile station 20 may comprise several different communications means. These may include different data and/or speech mobile communications systems, such as NMT or GSM or CDMA or other, facsimile, electronic mail, SMS messages or any other form of mobile communication. In the case of alarm the mobile station 20 can transmit an emergency signal in data form or a previously recorded voice mail, but in addition, the connection 100 may be left open so the emergency alarm centre 30 can listen or follow by other means in real time the development of the situation in the surroundings of mobile station 20 after the alarm. The emergency alarm centre 30 can also follow the measurements of the health status measuring means 10 in real time if both the communications connections 100, 200 are left accessible. The mobile station 20 may also be designed and constructed to the same compartment as the health status measuring means 10.

In another preferable embodiment of the invention the connection 100 is held continuously open, and the mobile station 20 may continuously follow the

measurements of the health status measuring means 10. In another further preferable embodiment of the invention the communications connection 200 is held continuously open as well, in which case the emergency alarm centre 30 can continuously follow the measurements of the health status measuring means 10. It is also possible to arrange the connections 100, 200 to be open at certain known intervals for the transfer of health status information. The establishment of any communications connection 100, 200 may be initiated from any device 10, 20, 30 in the system. The aforementioned embodiment is especially advantageous in medical surveillance of people with heart disorders.

The figure 1B. describes an advantageous embodiment of the technical implementation of the case where the connection 200 is held continuosly open. Many relevant physiological indicators such as EKG, heart rate, brain activity, electrostatic potential of skin, and others can be presented as analog signals. However, speech is also an analog signal, but in a digital cellular mobile station, such as a GSM mobile phone, the analog speech signal is adapted to a digital signal, which is further processed in the DSP (Digital Signal Processor) of the mobile station. The DSP's of modern digital cellular mobile phones comprise many ways of analysing the coded speech signal, such as calculating autocorrelation coefficients, reflection coefficients, logarithmic area ratios and other parameters, which may be used in analysing the signal and replacing disturbances and noise from the signal. Noise and impulses from the signal may be recognized by using many modifications of the LPC (Linear Predictive Coding)-method, linear interpolation, polynomic interpolation etc.

In this embodiment the health status measuring means 10 constantly transmits an analog signal to the mobile station 20, which uses its signal processing means to recognize possible alarming changes in the health status signal. In case the health status measuring means 10 measures EKG, for example, can the waveform of an EKG-signal already be inserted in the digital cellular phone, and waveform of the received health status signal is compared to the reference EKG-signal, and huge deviations from the reference-signal are detected. It is also possible to detect abnormal EKG-pulses by similar methods with which abnormal noise and impulses are detected from a speech signal, ie. by detecting unreasonable amplitudes and timings by the aforementioned mathematical methods. In this embodiment,

the A/D-adapter 5 may lie anywhere between the DSP 7 of the mobile station 20 and the health status measuring means 10.

Figure 2. features many health status measuring means 10, 11, 12, 13 in connection with one mobile station 20, which provides the only communications access to the emergency alarm centre 30. This embodiment is practical and economical in cases where the people wearing the health status measuring means 10 live or work together. If the range of the connections 100, 101, 102 and 103 is adequate, for instance a retired couple might benefit from getting only one mobile station, provided they spend most of their time near enough each other for the connection 100, 101, 102, or 103 to function. In this embodiment, the mobile station 20 recognizes which health status measuring means 10, 11, 12, 13 sent the emergency signal, if it is not already contained in the signal, and transmits the information location, health status, type of help needed to the emergency alarm centre 30 as outlined in the explanation of figure 1.

Figure 3. features one health status measuring means 10 in connection with several mobile stations 20, 21, 22, 23, 24. This embodiment is essential when establishing connection from the mobile station 20, 21, 22, 23, 24 to the emergency alarm centre 30 may be difficult. This kind of situation is likely to arise if there are many cellular networks available and their radio coverage differs. If one mobile station 20 is subscribed to only one cellular network, there might be areas where this particular mobile station 20 fails to form a connection because of poor radio coverage, even though some other cellular network might have adequate radio coverage on the area in question. However, if there are several mobile stations 20, 21, 22, 23, 24 subscribed to different cellular networks and the health status measuring means 10 can establish connection 100 to all or some of them, it is likely that even though some mobile station, say 22, 24, might fail in establishing connection to the emergency alarm centre 30, other mobile stations, say 20,21,23, may indeed succeed. One preferable but optional feature of this embodiment is that if there are more than one successful mobile stations 20, 21, 22, 23, 24, only one of these will transmit the emergency signal to the emergency alarm centre 30, and other mobile stations will abort their messages in order to avoid congestion, confusion and false alarms. It is also possible that the different mobile stations 20, 21, 22, 23, 24 are carried by different people or lie in different locations. In some buildings there are rooms which have poor radio

coverage, while other rooms do not. In this kind of situation, one of the mobile stations 20, 21, 22, 23, 24 can be situated in a room with guaranteed radio coverage, just to make sure that at least one radio connection to the emergency alarm centre can be established.

The embodiment in question is also useful in situations where other disturbances are likely to cause uncontinuous operation time for a single mobile station 20, such as disturbances caused by recharging the battery etc.. Thus, the aforementioned embodiment allows mobile stations 20, 21, 22, 23, 24 to work shiftwise.

Figure 4. features several health status measuring means 10, 11, 12, several mobile stations 20, 21, and an emergency alarm centre 30. All or some of the health status measuring means 10, 11, 12 are connected to mobile stations 20, 21 via communications connections 100, 101, 110, 111, 120, 121. The mobile stations are further connected to each other with connection 2021 and to the emergency alarm centre 30 with the connections 200, 210. The emergency alarm centre 30 may also exchange information with the other emergency alarm centre 31 through connection 301.

A preferable embodiment of the invention can be effectively utilised in team operations which may impose health hazards to the team members. Such operations may include police operations, life saving operations, diving operations, operations of the fire brigade, some military operations, to name just a few. In this embodiment of the invention if any of the health status measuring means 10, 11, 12 executes an alarm, the alarm can be routed via many alternative ways to the emergency alarm centre 30. For example, in a fire saving operation a fireman carrying the health status measuring means 10 and mobile station 20 might get into an accident and break his mobile station 20, thus abolishing the connection 100. In this case, the embodiment in question still allows the health status of the user of health status measuring means 10 to be monitored, and the emergency signals and the monitoring are carried out via the connections 101 and 210.

From the above explanation it is obvious that the emergency alarm centres 30 , 31 can have communications connections to other emergency alarm centres and exchange information via these connections.

Another further advantageous embodiment of the invention can be utilised in athletic training. In this embodiment the health status measuring means 10, 11, 12 measures some relevant physiological indicator related with the extent of physical exercise, such as heart rate or calory consumption. The mobile stations 20, 21 receive exercise status information from all health status measuring means 10, 11, 12 via connections 100, 101, 110, 111, 120, 121 and/or from other mobile stations via connection 2021. With this system a particular athelete carrying, say health status measuring means 10 and mobile station 20 can receive the exercise status information of another athelete carrying, say health status measuring means 11 and mobile station 21, and compare this exercise information to his own exercise information. The exercise information may be displayed by either the health status measuring means 10, 11, 12, or the mobile station 20, 21. In this embodiment of the invention the mobile station 20, 21 and the health status measuring means 10, 11, 12 are preferably incorporated to the same unit to increase the convenience in use during active training.

The exercise information of both atheletes can also be read from the emergency alarm centre 30, which in this case is preferably a communications terminal located with the coach of the two atheletes. This embodiment of the invention is especially valuable in very technical competitive sports, such as rowing, cycling, swimming etc., where the objective is to move fast with using minimum power and optimum technique.

All of the aforementioned embodiments may be realised with different kinds of health status measuring means 10, 11, 12, 13. The health status measuring means 10, 11, 12, 13 may measure all or some of the following physiological parameters: radioactive radiation dose, UV radiation, dehydration, heart rate, EKG, body temperature, blood pressure, synaptic nerve activity, brain activity, electrostatic potential of the skin, mechanical shock or pressure imposed on the body, or any other relevant physiological parameter. Especially combining the measurement of some related and relevant physiological parameters can be an advantageous embodiment to some users. For example, for people suffering from excess exposure to the sun a health status measuring means 10, 11, 12, 13 measuring dehydration, UV dose and body temperature may detect the relevant health hazards with high accuracy.

In all of the described embodiments, it is always possible for the user of the health status measuring means to cancel an false emergency signal by performing some simple operation on either the health status measuring means (10, 11, 12, 13) or on the mobile station (20, 21, 22, 23, 24) or on to both. The operation in question could be eg. pushing a cancel button.

The preceding text relates to the Finnish patent application number: 973128, from which this application requests priority of. The following text and the patent claims are concerned with the invention contained in this application.

The invention

The invention of this application relates to a method for mobile analysis and communication of health status information. The health status measuring means is arranged to measure any physiological parameter or signal, which may be processed in the form of a signal. The health status measuring means is essentially a heart rate monitor and/or an EKG -monitor and the health status measurements are essentially heart rate measurements and/or EKG - signal measurements.

The applicant is aware of any prior art solutions only in the field of heart monitoring.

Prior art solutions of mobile heart rate monitors usually transmit the heart rate- or EKG -signal telemetrically in the form of an analog signal to a telemetric receiver, which is usually implemented in the form of a wristwatch. Usually the receiver interprets the heart rate from the frequency of the analog signal or, possibly from the frequency of bursts, which are abrupt changes in the amplitude of the signal. It is also possible to interpret cardiological information from the amplitude of the bursts or from the amplitude of the analog signal. In addition to the pulse signal, the analog signal usually contains a recognition signal, which is distinct for every heart rate monitor transmitter and receiver pair. The recognition signal prevents the possible interference from other transmitters or receivers.

Prior art solutions only measure the heart rate or EKG -signal and display it to the user of the heart rate monitor. In prior art solutions the heart rate or EKG -signal is not analysed nor interpreted in ways outlined in the priority

application, nor in any other suitable way. The objective of this invention is to present a method for mobile analysis and communication of health status information, and especially cardiological information, with which this method some of the essential embodiments explained in the priority document may be made more feasible and easier to implement.

The invention characteristically features a method for mobile analysis and communication of health status information, in which characteristically,
- the health status measuring means is arranged to transmit continuously or at certain intervals a signal composed of the health status measurements of the user to the mobile station,
- in the said signal the health status measurements of the user are in some relation to the frequency, wavelength, period, intensity and/or amplitude of the said signal, and/or to the frequency, wavelength, period, intensity and/or the amplitude of bursts in the said signal.
- the mobile station is arranged to use its signal processing means to distinguish an alarming change or point in the signal transmitted, and sends an emergency signal to the emergency alarm centre, if such an alarming change or point is detected.

The preferable embodiments of the invention are described in the dependent claims.

Some of the preferable embodiments of the invention are also explained in more detail with reference to the following drawings.

Figure 5. presents a typical analogical physiological signal, an EKG -signal.

Figure 6. presents the signal of Figure 5. in digitally processed form.

The signal in Figure 5. presents an analogical EKG -signal, which is designated by number 50. The invention is explained in the following with reference to the physiological parameter being the EKG -signal 50 of the user. In this embodiment the health status measuring means (10, 11, 12, 13) is essentially a heart rate and/or EKG -monitor, and the transmitted signal is essentially composed of the heart rate measurements and/or the EKG -signal 50 of the user. However, it is completely obvious that measurements of any

other physiological parameter can be analysed and processed with the same methods in accordance with the invention.

The figure 5. shows two complete cycles, where the waveform 52 shows the part of the signal which causes the contraction of the atria. Waveform 51 presents the QRS -complex and at 53 the heart is returning to its resting state. The line 54 shows the interval between the two consecutive waveforms, QRS -complexes in this case, from which the heart rate may directly be deduced. The wavelength, i.e. the period 54 of the signal also directly describes the frequency of the signal.

Possible abnormalities which may result in severe cardiological disorders may be detected from the signal of the heart rate monitor and/or EKG - monitor 10, 11, 12, 13, in various ways, depending on the way with which information is transmitted with the signal. Usually the transmission of the signal is established with a telemetric connection, based on capacitive and/or inductive effects in a short-range magnetic field. However, other electromagnetic, optic or sonar transmission means, wired or wireless may be used as well.

If the frequency of the signal or the frequency of bursts in the signal is adjusted proportional to the heart rate or the frequency of the EKG -signal 50, which is inversely proportional to the wavelength i.e. period of the signal 54, any abnormal changes in heart function, such as defibrillation or heart attack, may be deduced from the signal frequency and/or period 54. Many times also the frequency of occurrence of some specific waveform in the EKG-signal 50 is observed, such as the QRS -complex 51.

The period 54 of the signal in itself may also be used as a criteria in similar ways to the frequency of the signal. Likewise, the heart rate or the EKG - signal 50 is also related to the amplitudes of the signal, and any abnormal changes or an abnormal state of heart function may be deduced from the amplitudes of the signal, or from the amplitudes of some specific waveforms 51, 52, 53 in the signal.

Thus, any abnormalities in the amplitude, duration, intensity frequency, period and/or form of any of the waveforms 51, 52, 53 of the EKG -signal 50, may be analysed with any analogical signal processing means that may be

implemented in a mobile station 20, 21, 22, 23, 24 or a emergency alarm centre 30, 31.

Figure 6. presents the digitally processed form 60 of the EKG signal 50 in Figure 5. The signal part 62 corresponds to the digitized form of the waveform 52, 61 corresponds to the digitized waveform of 51, and 63 corresponds to the digitized waveform of 53. 64 corresponds to the interval 54.

After the signal 50 of figure 5. has been adapted to the digital form 60 of figure 6., the amplitudes, frequency, wavelength and period 64 of the digitized physiological signal are analysed in a similar way to processing of the health status information in the priority application. A digital signal processor (7) or some other processor means recognizes abnormal points from the said signal by using LPC, CELP (Code Excited Linear Prediction), linear interpolation, polynomial interpolation, calculation of autocorrelation coefficients, calculation of reflection coefficients, calculation of logarithmic area ratios, or other essentially known mathematical instruments, and/or previous and/or statistical information concerning the said signal. Abnormalities in the amplitude, duration, intensity frequency, period and/or form of any of the waveforms 61, 62, 63, may be analysed with the aforementioned techniques. When the cardiological disorder has been observed, the mobile station 20, 21, 22, 23, 24 contacts the emergency alarm centre 30, 31 automatically and help is dispatched to the location of the user of the mobile station.

The signals 50 and 60 presented in figures 5. and 6. may be realised also in the form of bursts, where a sudden increase in amplitude contains the relevant information about the signal. In this embodiment, a burst signal could be composed, for example by transmitting the waveforms of the QRS complex 51, 61 as bursts and neglecting some or all other waveforms 52, 53, 62, 63. In this case also the abnormalities in the amplitude, duration, intensity, frequency, period and/or form of any of the bursts 51, 61 would be recognised with the same aforementioned techniques.

The relevant components, such as the A/D -adapter (5) or the digital signal processor (7) may be realised in alternative parts of the arrangement. The recognition signal or some other additional signal may be used also in

notifying the signal processor means, such as the DSP (7) of parts of the signal which have a higher likelihood of containing an abnormality, so that most of the processing power may be applied in analysing these relevant sequences. The recognition signal may be, for example, an AM -modulation in the burst signal, a typical frequency sequence, or a typical phase transition sequence.

It is also possible to realise the system in accordance with the invention with an analogical mobile station. In this case, the analogical mobile station uses its analogical signal processing means to recognize abnormalities from the analogical heart rate- and/or EKG-signal 50. In any case, the invention does not demand dramatic changes to the technology already implemented in cardiological measurement techniques and mobile communications.

The method in accordance with the invention presents a solution for mobile analysis and communication of health status information. Especially, the method in accordance with the invention presents a solution for mobile analysis and communication of cardiological information. However, it is obvious that the method in accordance with the invention may be arranged to analyse and communicate also other physiological information, not only cardiological information. The method in accordance with the invention may, for example, be arranged to measure radioactive radiation dose, UV radiation, dehydration, body temperature, blood pressure, synaptic nerve activity, brain activity, concentration of blood sugar, electrostatic potential of the skin, mechanical shock or pressure imposed on the body, breathing frequency, respiration rate, concentration of a foreign substance in blood, such as alcohol, heroine, cocaine, or any other foreign substance, or any other relevant physiological parameter which may be processed in form of a signal.

The invention has been explained with reference to the aforementioned embodiments. However, it is clear that the invention is not only limited to these embodiments, but covers all embodiments within the spirit and scope of the invention and the following claims.

Patent claims

1. A personal health status alarm method wherein the personal health status alarm method comprises a mobile station (20), a health status measuring means (10), an emergency alarm centre (30) and a communications connection (100), via which the mobile station and the health status measuring means are arranged to communicate with each other, and a communications connection (200), via which the mobile station (20) and the emergency alarm centre (30) are arranged to communicate with each other, **characterised** in that,
- the health status measuring means (10, 11, 12, 13) is arranged to transmit continuously or at certain intervals a signal composed of the health status measurements of the user to the mobile station (20, 21, 22, 23, 24),
- in the said signal the health status measurements of the user are in some relation to the frequency, intensity, period, wavelength and/or amplitude of the said signal, and/or to the frequency, intensity, period, wavelength and/or the amplitude of bursts in the said signal.
- the mobile station (20, 21, 22, 23, 24) is arranged to use its signal processing means to distinguish an alarming change or point in the signal transmitted, and sends an emergency signal to the emergency alarm centre (30, 31), if such an alarming change or point is detected.

2. A personal health status alarm method wherein the personal health status alarm method comprises at least one mobile station (20, 21, 22, 23, 24), at least one health status measuring means (10, 11, 12, 13), at least one emergency alarm centre (30) and communications connections (100, 101, 102, 103, 104, 110, 111, 120, 121), via which the mobile stations (20, 21, 22, 23, 24) and the health status measuring means (10, 11, 12, 13) are arranged to communicate with each other, and/or communications connections (2021), via which mobile stations are arranged to communicate health status information to each other, and communications connections (200, 201, 202, 203, 204,) via which the mobile stations (20, 21, 22, 23, 24) and the emergency alarm centres (30, 31) are arranged to communicate with each other, **characterised** in that,

3. A personal health status alarm method in accordance with Claim 1 or 2, **characterised** in that, the emergency alarm centres (30, 31) are arranged to communicate with each other via connection (301).

4. A personal health status alarm method in accordance with Claim 1 or 2, **characterised** in that,
-the health status measuring means (10, 11, 12, 13) is arranged to send an emergency signal to the mobile station (20, 21, 22, 23, 24) via communications connections (100, 101, 102, 103, 104, 110, 111, 120, 121) if the health status measuring means (10, 11, 12, 13) measures a significant change in the health status of the user,
-the mobile stations (20, 21, 22, 23, 24) are arranged to receive emergency signals from health status measuring means (10, 11, 12, 13) and/or from other mobile stations (20, 21, 22, 23, 24), and the mobile stations (20, 21, 22, 23, 24) are arranged to transmit emergency signals to emergency alarm centres (30) via communications connections (200, 201, 202, 203, 204) and other mobile stations (20, 21, 22, 23, 24) via communication connection (2021).

5. A personal health status alarm method in accordance with any of the preceding claims, **characterised** in that, the communications connections (100, 101, 102, 103, 104, 110, 111, 120, 121, 200, 201, 202, 203, 204, 301, 2021), are arranged to transmit and receive with different data and/or speech mobile communications systems, such as NMT or GSM or CDMA or other, facsimile, electronic mail, SMS messages, or other speech or data signals.

6. A personal health status alarm method in accordance with any of the preceding claims, **characterised** in that, the establishment of any communications connection (100, 101, 102, 103, 104, 110, 111, 120, 121, 200, 201, 202, 203, 204, 301, 2021) may be initiated from any device (10, 11, 12, 13, 20, 21, 22, 23, 24, 30, 31) in the system.

7. A personal health status alarm method in accordance with any of the preceding claims, **characterised** in that, the emergency signal is arranged to contain the location of the user in emergency, the nature of the emergency, any information relating to the health status of the user, or any other relevant information relating to the emergency.

8. A personal health status alarm method in accordance with Claim 1 or 2 and/or with any of the claims 3-7 **characterised** in that, the health status of the user of the health status measuring means (10, 11, 12, 13) is arranged to be observed continuously or at known intervals by the emergency alarm centre (30, 31) via communications connections (100, 101, 102, 103, 104, 110, 111, 120, 121, 200, 201, 202, 203, 204, 2021).

9. A personal health status alarm method in accordance with Claim 1 or 2 and/or with any of the claims 3-7 **characterised** in that, the health status of the user of the health status measuring means (10, 11, 12, 13) is arranged to be observed continuously or at known intervals by the mobile station (20, 21, 22, 23, 24) via communications connections (100, 101, 102, 103, 104, 110, 111, 120, 121).

10. A personal health status alarm method in accordance with Claim 1 or 2 and any of the claims 3-9 **characterised** in that, the emergency alarm centre (30, 31) is arranged to detect an alarming change in the health status of the user of the health status measuring means (10, 11, 12, 13) from the basis of the said observed measurements conducted to the user by the health status measuring means (10, 11, 12, 13).

11. A personal health status alarm method in accordance with Claim 1 or 2 and any of the claims 3-9 **characterised** in that, the mobile station (20, 21, 22, 23, 24) is arranged to detect an alarming change in the health status of the user of the health status measuring means (10, 11, 12, 13) from the basis of the said observed measurements conducted to the user by the health status measuring means (10, 11, 12, 13).

12. A personal health status alarm method in accordance with Claim 1 or 2 and any of the claims 3, 5-9 ,11,13, **characterised** in that, the said mobile station is a GSM-mobile station.

13. A personal health status alarm method in accordance with Claim 1 or 2 and and any of the claims 3, 5-9 ,11,12, **characterised** in that, the said signal is an EKG-signal.

14. A personal health status alarm method in accordance with any of the preceding claims, **characterised** in that, the communications connections

(100, 101, 102, 103, 104, 110, 111, 120, 121) are preferably infra-red or radio connections and the communications connections (200, 201, 202, 203, 204, 2021) are preferably radio connections.

15. A personal health status measuring means, **characterised** in that, the personal health status measuring means (10, 11, 12, 13) is arranged to measure physiological parameters of the user,
- the personal health status measuring means (10, 11, 12, 13) is arranged to compare the measured values of physiological parameters to previous values and/or to threshold values of the physiological parameters and/or to some relevant mathematical function or relation, and
- on the basis of this comparison the personal health status measuring means (10, 11, 12, 13) is arranged to send an emergency signal via a communications connection (100, 101, 102, 103, 104, 110, 111, 120, 121) to a mobile station (20, 21, 22, 23, 24).

16. A personal health status measuring means, **characterised** in that, the personal health status measuring means (10, 11, 12, 13) is arranged to measure physiological parameters or signals of the user, and
- the personal health status measuring means is arranged to transmit the physiological parameters or signals as analog or digital signals to the mobile station (20, 21, 22, 23, 24) continuously or at certain intervals according to the preference, or the type of signal processing ability of the mobile station (20, 21, 22, 23, 24).

17. A personal health status measuring means in accordance with claim 15 or 16, **characterised** in that, the personal health status measuring means 10, 11, 12, 13 is arranged to measure physiological parameters, such as heart rate, EKG, blood pressure, radioactive radiation dose, UV radiation, dehydration, body temperature, synaptic nerve activity, brain activity, mechanical shock or pressure imposed on the body and/or electrostatic potential of the skin.

18. A personal health status measuring means in accordance with any of the claims 15 or 16 and a personal health status alarm method in accordance with any of the claims 1-14, **characterised** in that,
- the health status measurements conducted by a health status measuring means (10, 11, 12, 13) are arranged to be compared with at least one

measurement or set of measurements conducted by at least one other health status measuring means,
- the said comparison is arranged to be executed in a health status measuring means (10, 11, 12, 13), mobile station (20, 21, 22, 23, 24) or a emergency alarm centre (30, 31), and the measurements and/or comparisons are displayed by a health status measuring means (10, 11, 12, 13), a mobile station (20, 21, 22, 23, 24) or a emergency alarm centre (30, 31).

19. A personal health status measuring means in accordance with any of the claims 15-18 and a personal health status alarm method in accordance with any of the claims 1-17, **characterised** in that, the said health status measurements and the said comparisons of the said health status measurements are arranged to be used in obtaining exercise information in physical training.

20. A personal health status alarm method and a health status measuring means in accordance with any of the preceding claims, **characterised** in that, the user is arranged to have the possibility to cancel the emergency signal if the user so wishes.

21. A method for mobile analysis and communication of health status information in accordance with Claim 1, **characterised** in that,
- the health status measuring means (10, 11, 12, 13) is arranged to transmit continuously or at certain intervals a signal composed of the health status measurements of the user to the mobile station (20, 21, 22, 23, 24),
- in the said signal the health status measurements of the user are in some relation to the frequency, intensity, period, wavelength and/or amplitude of the said signal, and/or to the frequency, intensity, period, wavelength and/or the amplitude of bursts in the said signal.
- the mobile station (20, 21, 22, 23, 24) is arranged to use its signal processing means to distinguish an alarming change or point in the signal transmitted, and sends an emergency signal to the emergency alarm centre (30, 31), if such an alarming change or point is detected.

22. A method for mobile analysis and communication of health status information in accordance with Claim 1 or 21, **characterised** in that, the said signal is related to the timing, frequency, duration and/or amplitude of at least one waveform of the health status signal.

23. A method for mobile analysis and communication of health status information in accordance with Claim 1,21 or 22, **characterised** in that,
- the said signal sent by the health status measuring means (10, 11, 12, 13) is an analog signal,
- the said mobile station (20, 21, 22, 23, 24) is a digital mobile station, comprising a digital signal processor (7),
- an A/D -adapter (5) is arranged to adapt the said analog signal to a digital signal, before the said signal enters the digital signal processor (7).

24. A method for mobile analysis and communication of health status information in accordance with any of the claims 1 or 21, 22, 23 **characterised** in that,
- the A/D -adapter (5) is realised to the mobile station (20, 21, 22, 23, 24) and/or to the health status measuring means (10, 11, 12, 13),
- the digital signal processor (7) is located to the mobile station (20, 21, 22, 23, 24) and/or to the health status measuring means (10, 11, 12, 13).

25. A method for mobile analysis and communication of health status information in accordance with any of the claims 1, 21-24, **characterised** in that,
- the digital signal processor (7) or any other signal detection means in the health status measuring means (10, 11, 12, 13), mobile station (20, 21, 22, 23, 24) or emergency alarm centre (30, 31) is arranged to recognize abnormal points from the said signal by using LPC, CELP, linear interpolation, polynomial interpolation, calculation of autocorrelation coefficients, calculation of reflection coefficients, calculation of logarithmic area ratios, or other essentially known mathematical instruments, and/or previous and/or statistical information concerning the said signal.

26. A method for mobile analysis and communication of health status information in accordance with any of the preceding claims, **characterised** in that, the digital signal processor (7) or any other signal detection means in the health status measuring means (10, 11, 12, 13), mobile station (20, 21, 22, 23, 24) or emergency alarm centre is arranged to recognize abnormal and/or alarming changes or points in the said signal by comparison of the amplitude, frequency, period, intensity and/or wavelength of the said signal and/or of the amplitude, frequency, period, intensity and/or wavelength of bursts in the said

signal to certain threshold values or mathematical relations, which values and mathematical relations may be composed in ways described in claim 24.

27. A method for mobile analysis and communication of health status information in accordance with any of the preceding claims, **characterised** in that, in addition to the said signal sent from the health status measuring means (10, 11, 12, 13) to the mobile station (20, 21, 22, 23, 24) an additional signal is arranged to be incorporated to the said signal or arranged to be sent separately to the mobile station (20, 21, 22, 23, 24), indicating some parts of the health status -signal which may contain abnormal and/or alarming points or changes in this signal.

28. A method for mobile analysis and communication of health status information in accordance with the claim 27, **characterised** in that, the said additional signal is the distinct recognition signal, one of the distinct recognition signals, an A/M modulated recognition signal, or a phase transition sequence of the transmitter-receiver pair in question.

29. A method for mobile analysis and communication of health status information in accordance with any of the preceding claims, **characterised** in that, the said health status measuring means is arranged to measure radioactive radiation dose, UV radiation, dehydration, body temperature, blood pressure, synaptic nerve activity, brain activity, concentration of blood sugar, electrostatic potential of the skin, mechanical shock or pressure imposed on the body, breathing frequency, respiration rate, concentration of a foreign substance in blood, such as alcohol, heroine, cocaine, or any other foreign substance, or any other relevant physiological parameter which may be processed in form of a signal.

30. A method for mobile analysis and communication of health status information in accordance with any of the preceding claims, **characterised** in that,

- the said health status measuring means (10, 11, 12, 13) is a heart rate- and/or EKG -monitor,
- the said measurements and the said signal is composed of or related to the heart rate measurements and/or the EKG-signal (50, 51, 52, 53, 54, 60, 61, 62, 63, 64) of the user.

31. A method for mobile analysis and communication of cardiological information in accordance with any of the preceding claims, **characterised** in that, the said signal is related to the timing, frequency, duration and/or amplitude of at least one waveform of the EKG-signal (50, 60), such as the QRS-complex (51, 61).

32. A method for mobile analysis and communication of health status information in accordance with any of the preceding claims, **characterised** in that, the said mobile station (20, 21, 22, 23, 24) is a GSM-mobile station.

33. A method for mobile analysis and communication of health status information in accordance with any of the claims 1-2, 21, 24-31, **characterised** in that, the mobile station (20, 21, 22, 23, 24) is an analogical mobile station and is arranged to use its analogical signal processing means in processing the analogical said signal.

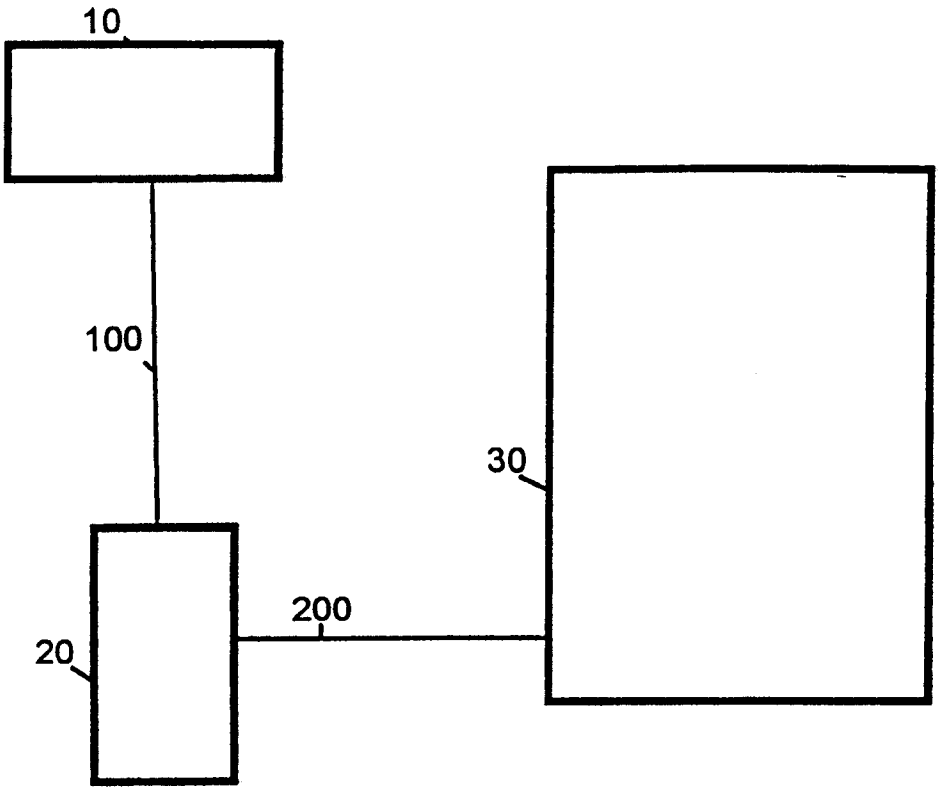


FIG1.

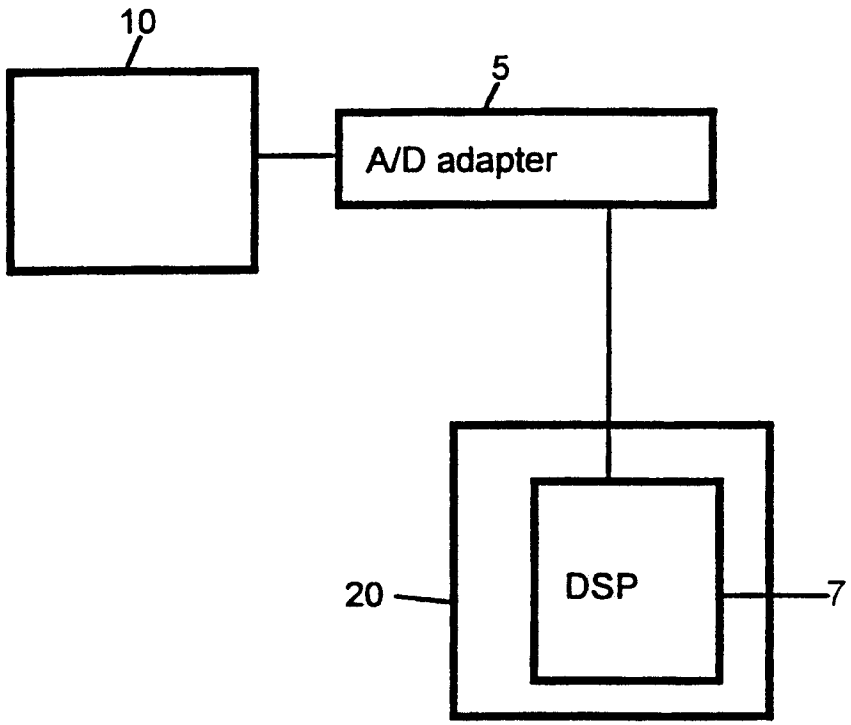


FIG 1B.

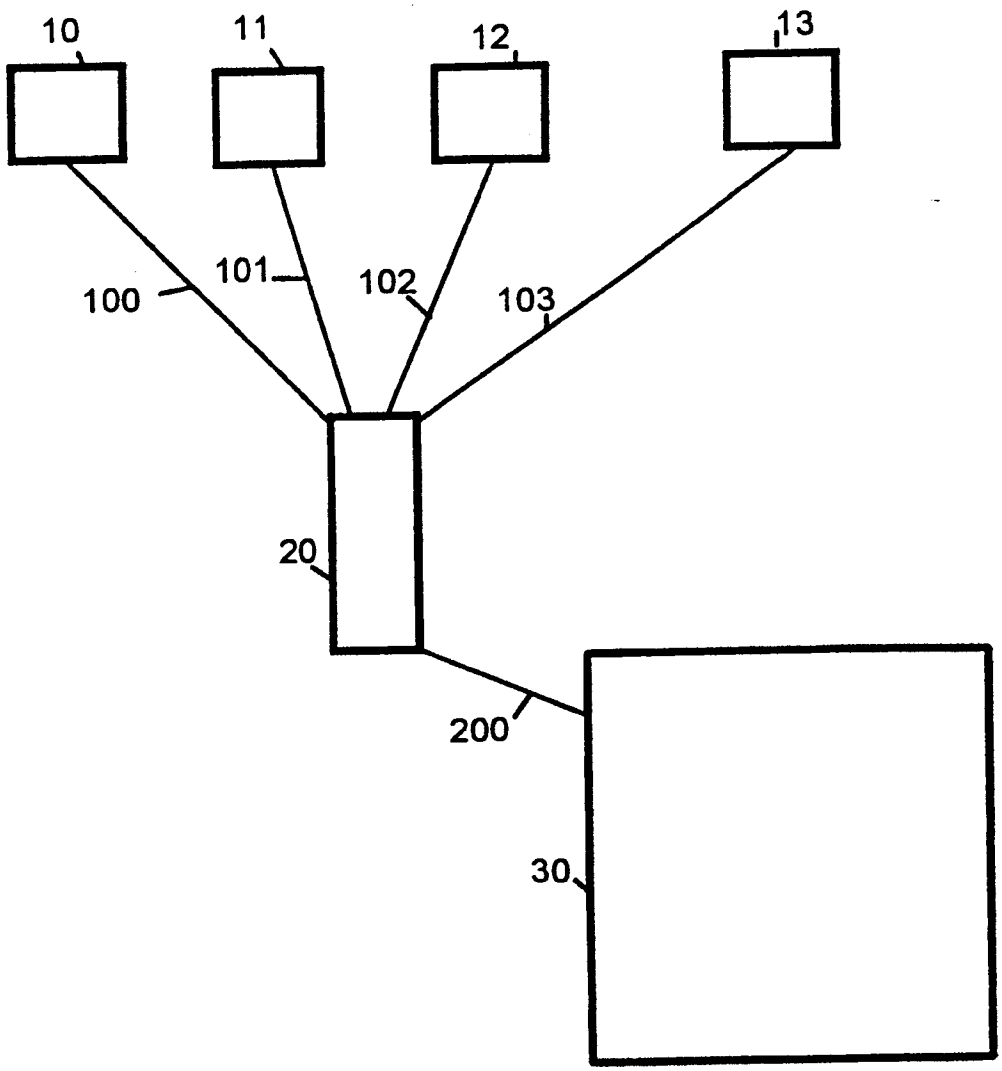


FIG2.

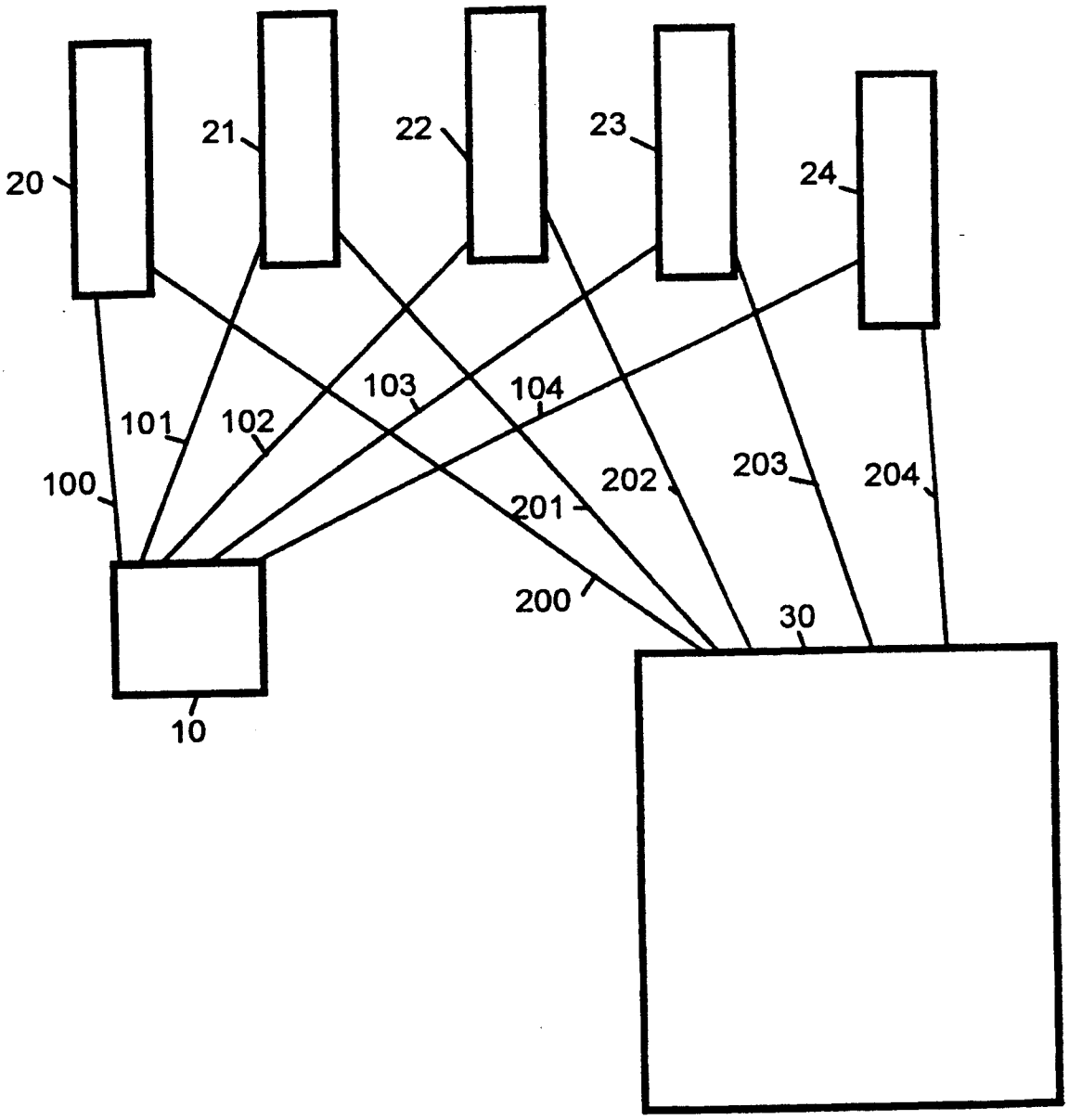


FIG3.

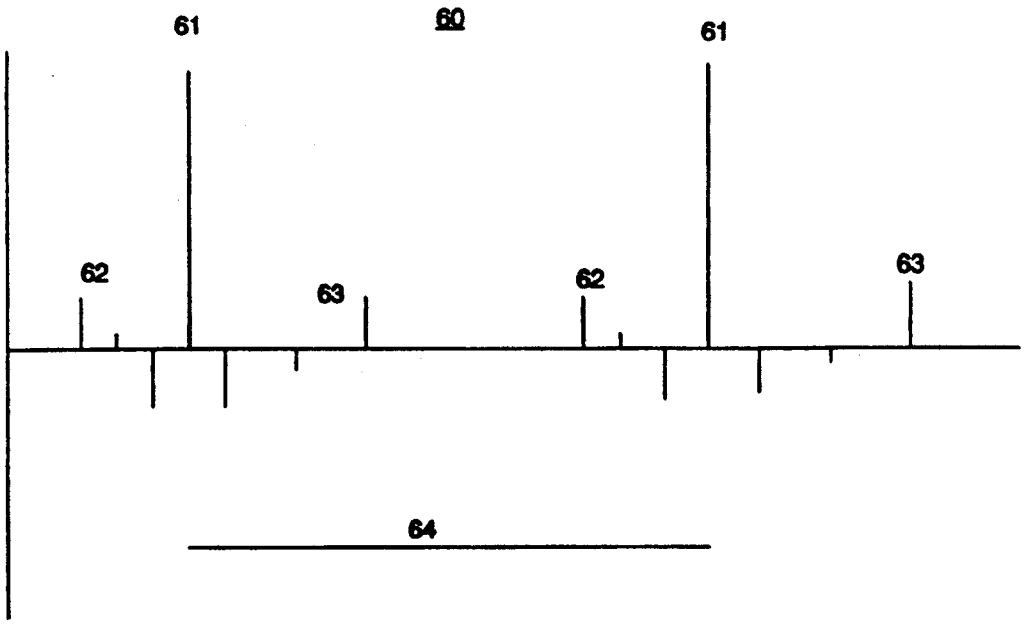


FIG 6.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00603

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A61B 5/00, G08B 25/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A61B, G08S, G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5544661 A (CHARLES L. DAVIS ET AL), 13 August 1996 (13.08.96), figures 1,5, abstract --	1-33
X	US 5462051 A (T.OKA ET AL), 31 October 1995 (31.10.95), column 3, line 22 - column 4, line 4, figure 1, abstract --	1-33
A	WO 9721109 A1 (SYMMETRICOM.INC.), 12 June 1997 (12.06.97), abstract --	1-33
A	FI 100941 B (LEITZINGER OY), 15 March 1995 (15.03.95), see the whole document --	1,15

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 December 1998	28 -12- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Joni Sayeler Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00603

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5153584 A (C.ENGIRA), 6 October 1992 (06.10.92), see the whole document ---	1-33
A	US 5458123 A (J.D.UNGER), 17 October 1995 (17.10.95), see the whole document ---	1-33
A	EP 0766096 A2 (SCHIMADZU CORPORATION), 2 April 1997 (02.04.97), see the whole document --- --------	1-33

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/12/98

International application No.
PCT/FI 98/00603

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5544661 A	13/08/96	NONE	
US 5462051 A	31/10/95	NONE	
WO 9721109 A1	12/06/97	AU 1036797 A	27/06/97
		EP 0866983 A	30/09/98
		GB 2308033 A	11/06/97
		GB 9524754 D	00/00/00
		GB 9625049 D	00/00/00
FI 100941 B	15/03/95	AU 7616594 A	03/04/95
		EP 0724402 A	07/08/96
		FI 934012 A	15/03/95
		JP 9502374 T	11/03/97
		US 5670944 A	23/09/97
		WO 9507652 A	23/03/95
US 5153584 A	06/10/92	NONE	
US 5458123 A	17/10/95	EP 0602459 A	22/06/94
EP 0766096 A2	02/04/97	JP 9149921 A	10/06/97
		US 5754136 A	19/05/98